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<b>(54) Title:</b> AQUEOUS CLEANER/DEGREASER EMULSION COMPOSITIONS  <b>(57) Abstract</b>  Stable, aqueous cleaner/degreaser emulsion compositions are formulated with at least one sparingly soluble organic solvent having specified compositional characteristics, a solubilizing additive and water. The solubilizing additive may consist of from approximately 0.1 to approximately 100 weight percent of a surfactant and from 0 to approximately 99.9 weight percent of a coupler and is present in an amount insufficient to solubilize all of the total organic solvent content but sufficient to emulsify the unsolubilized portion of the total organic solvent content. The emulsion compositions so formulated provide enhanced degreasing efficacies.		

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AQUEOUS CLEANER/DEGREASER  
EMULSION COMPOSITIONS

Background of the Invention

This invention relates to cleaner/degreaser compositions and, more particularly, to stable, aqueous cleaner/degreaser compositions in the form of emulsions which exhibit improved degreasing efficacies.

Heretofore, the conventional and available cleaner/degreaser emulsion compositions have been water in oil or oil in water emulsions in which the organic solvent component is an inherently water insoluble organic solvent. Such available emulsion compositions include, for example, those marketed under the trade designations "Off" asphalt remover which contains the water insoluble solvents toluene and o-dichlorobenzene emulsified with a tall oil amide. Other available emulsion compositions contain water insoluble aromatic solvents such as xylene, kerosene, mineral spirits, benzene or naphthalene emulsified with various surfactants to form oil in water emulsions.

Illustrative of such available emulsions are those marketed under the trade designations "Brulin 512M", "Spartan WRD-160", "Betco Emulsifiable Solvent Degreaser", "Amrep Jel-Sol", and "DuBois Actusol". In the preparation of such emulsions, an inherently water insoluble organic solvent, typically a hydrocarbon solvent, is emulsified with one or more surfactants soluble in the solvent component. When this nonaqueous emulsion or solution is combined with water, a true milky emulsion is formed in which essentially none of the solvent component and only a relatively small amount of the surfactant component is dissolved in the aqueous phase. Thus, the cleaning/degreasing efficacy of such emulsion compositions is almost entirely derived from the nonaqueous or discontinuous phase of the emulsion containing the solvent component necessary to remove oleophilic (hydrophobic) soilants.

While conventional cleaner/degreaser emulsion compositions possess some degree of efficacy, there is a need for cleaner/degreaser emulsion compositions which exhibit improved efficacy, particularly with respect to grease and oil removing efficacy.

#### Summary of the Invention

Among the several objects of the invention may be noted the provision of stable, aqueous cleaner/degreaser emulsion compositions having improved cleaning/degreasing efficacy; the provision of such emulsion compositions which are formulated to provide a portion of the organic solvent content in both the aqueous and nonaqueous phases of the emulsions; the provision of emulsion compositions of this type which may be formulated in various forms including lotions, creams, and aerosol forms; the provision of such emulsion compositions which have a low level of odor, are nontoxic and nonhazardous in use; the provision of such improved emulsion compositions which provide enhanced degreasing capabilities; the provision of such emulsion compositions which possess either a low order of combustibility or are non-combustible, which have a high flash point, which are safe to use and which are biodegradable; and the provision of such improved emulsion compositions which incorporate organic solvents with inherently limited aqueous solubility and which may be readily formulated from available components. Other objects and features will be in part apparent and in part pointed out hereinafter.

Briefly, the present invention is directed to stable, aqueous cleaner/degreaser emulsion compositions which comprise:

(a) at least one sparingly soluble organic solvent characterized by:

- 5 (i) having a water solubility in the range of approximately 0.05 to approximately 6 weight percent;
- (ii) not being a hydrocarbon or halocarbon;
- (iii) having one or more similar or dissimilar oxygen, nitrogen, sulfur, or phosphorous containing functional groups;
- 10 (iv) being a solvent for hydrophobic soilants; and
- (v) being present in an amount exceeding its aqueous solubility;

15 (b) a solubilizing additive consisting of from approximately 0.1 to approximately 100 weight percent of a surfactant and from 0 to approximately 99.9 weight percent of a coupler, said solubilizing additive being present in an amount insufficient to solubilize all of the total  
20 organic solvent content but sufficient to emulsify the unsolubilized portion of the total organic solvent content; and

(c) water.

25 The emulsion compositions of the invention thus contain a portion of the organic solvent component in the aqueous or continuous phase of the emulsions and the remainder of the organic solvent component in the emulsion or discontinuous phase thereby providing enhanced degreasing efficacies.

Description of the Preferred Embodiments

In accordance with the present invention, it has now been found that stable, aqueous cleaner/degreaser emulsion compositions having improved degreasing capabilities can be formulated by combining at least one sparingly water soluble organic solvent having certain compositional and solvency characteristics and being present in an amount exceeding its aqueous solubility with a solubilizing additive and water, the solubilizing additive being present in an amount insufficient to solubilize all of the total organic solvent content but sufficient to emulsify the unsolubilized portion of the total organic solvent content. In the present invention, the solubilizing additive performs a dual function, i.e., it solubilizes a portion of the total content of the organic solvent component above its inherent aqueous solubility limit and it emulsifies the unsolubilized portion of the total organic solvent content. The resulting emulsion thus contains a portion of the sparingly water soluble organic solvent component in the aqueous or continuous phase of the emulsion and the remainder of the organic solvent component in the emulsified or oil phase of the emulsion. The latter phase effectively constitutes an organic solvent reservoir which provides enhanced degreasing efficacy over that provided by the organic solvent in the aqueous phase alone.

The enhanced degreasing efficacy derived from the dual function of the solubilizing additive in the present invention is in contrast with the cleaning/degreasing action of available emulsions in which essentially none of the water insoluble hydrocarbon or halocarbon organic solvent is present in the aqueous phase of the emulsions and the cleaning/degreasing activity is wholly dependent upon the presence of the water insoluble organic solvent in

the nonaqueous or discontinuous phase of the emulsions. The emulsions of the present invention also provide greater degreasing efficacies at equal or equivalent organic solvent levels over those provided by the aqueous cleaner/degreaser compositions disclosed in my copending, coassigned application Serial No. 373,813, filed June 29, 1989, which are formulated in the form of totally water soluble compositions.

The emulsion compositions of the invention are therefore characterized by having the sparingly water soluble organic solvent present in both the aqueous phase and nonaqueous or oil phase of the emulsions. The aqueous phase constitutes a saturated solution of the organic solvent by reason of the portion of the solvent being soluble in the aqueous phase to the extent of its inherent aqueous solubility therein and the portion of the solvent solubilized by the solubilizing additive into the aqueous phase. The excess or remaining portion of the total organic solvent content is emulsified into the nonaqueous phase of the emulsions and constitutes the reservoir of organic solvent chiefly responsible for the enhanced degreasing activity exhibited by the emulsions of the invention.

For use in the present invention, the sparingly water soluble organic solvent must have the following characteristics:

- (a) it must have limited water solubility in the range of approximately 0.05 to 6 weight percent;
- (b) it must not be a hydrocarbon or halocarbon;
- (c) it must have one or more similar or dissimilar oxygen, nitrogen, sulfur or phosphorous containing functional groups;

(d) it must be a solvent for hydrophobic soilants; and

(e) it must be present in an amount exceeding its limited aqueous solubility.

5 Preferably, the organic solvent has a water solubility in the range of approximately 0.05 to approximately 2.5 weight percent, more preferably between 1 and 2.5 weight percent. Organic solvents meeting these criteria provide superior cleaning/degreasing action when formulated in accordance  
10 with the invention.

The principal classes of organic solvents from which useful organic solvents may be selected include esters, alcohols, ketones, aldehydes, ethers and nitriles. These will generally contain one or more of the desired similar  
15 or dissimilar functional groups listed above. Examples of organic solvents containing similar functional groups from among those listed above include diethyl glutarate (2 ester groups), phenacyl acetone (2 keto groups), diethylethylene diphosphonate (2 phosphonate ester groups), ethylene-  
20 dipropionate (2 ester groups), decylene glycol (2 hydroxyl groups), m-dimethoxybenzene (2 ether groups), adiponitrile (2 nitrile groups), ethylene glycol dibutyl ether (2 ether groups), and diethyl-o-phthalate (2 ester groups). Among organic solvents containing dissimilar functional groups  
25 from among those listed above may be mentioned 2-phenoxyethanol (hydroxy, ether groups), 1-phenoxy-2-propanol (hydroxy, ether groups), N-phenylmorpholine (amino, ether groups), isopropylacetoacetate (keto, ester groups), o-methoxybenzyl  
30 alcohol (ether, hydroxy groups), 4'-methoxyacetophenone (ether, ketone groups), o-nitrophenetole (nitro, ether groups), 2-hexoxyethanol (hydroxy, ether groups), ethylcyano-acetoacetate (cyano, keto, ester groups),

p-anisaldehyde (ether, aldehyde groups), polypropylene glycol 1200, 2000, and 4000 (ether, hydroxyl groups), n-butoxy acetate (ether, ester groups), and 2-phenylthioethanol (thioether, hydroxyl groups).

5 In addition to the criteria listed above, it is also desirable but not essential that the organic solvent have a relatively low volatility or high flash point, exhibit a low level of odor, be chemically stable, nontoxic, non-hazardous, liquid or easily liquified at ambient  
10 temperatures, and commercially available.

The sparingly water soluble organic solvents which may be employed in the practice of the present invention (and comprising some of the solvents listed above) together with their aqueous ambient temperature solubility in wt.%  
15 include 2-phenoxyethanol (2.3) (marketed under the trade designation "Dowanol Eph"),  $\beta$ -phenoxy-2-propanol (1.1) (marketed under the trade designation "Dowanol PPh"), phenylethanol (1.6), acetophenone (0.5), benzyl alcohol (4.4), benzonitrile (1.0), n-butyl acetate (0.7), n-amyl  
20 acetate (0.25), benzaldehyde (0.3), N,N-diethylaniline (1.4), diethyl adipate (0.43), dimethyl-o-phthalate (0.43), n-amyl alcohol (2.7), N-phenylmorpholine (1.0), n-butoxyethyl acetate (EB acetate) (1.1), cyclohexanol (4.2), polypropylene glycol 1200 (2), dipropylene glycol  
25 mono-n-butyl ether (Dowanol DPnB) (5.0) cyclohexanone (2.3), isophorone (1.2), methylisobutyl ketone (2.0), methylisoamyl ketone (0.5), tri-n-butylphosphate (0.6), 1-nitropropane (1.4), nitroethane (4.5), dimethyl esters of mixed succinic, glutaric and adipic acids (5.7) (marketed  
30 under the trade designation "DBE ester" by DuPont), diethyl glutarate (0.88), diethyl malonate (2.08), poly-oxyalkylene polyols (e.g., polyoxypropylene diols and triols) such as the polypropylene glycols P1200, P2000 and P4000 (Dow Chemical), polypropylene glycol monobutyl ether

(Dow Polyglycol L-1150) and polyglycol copolymers containing ethenoxy and propenoxy units (Dow 112-2). As will be apparent to those skilled in the art, the above-listed sparingly water soluble organic solvents are merely illustrative and various other solvents meeting the criteria set out above may also be utilized in the practice of the invention. Because of their performance characteristics, lack of odor, low volatility/high flash point, chemical stability and availability,

2-phenoxyethanol and 1-phenoxy-2-propanol are the preferred organic solvents of choice. N-butoxyethyl acetate (EB acetate) and the dimethyl esters of mixed succinic, glutaric and adipic acids are also among the preferred organic solvents. For emulsions of the invention in the form of lotions and creams, the use of oligomeric, hydrophobic solvents having limited aqueous solubility and molecular weights of up to 5000, preferably below 4000, are preferred since they also function as emollients, lubricants, humectants, and skin conditioners and do not defat the skin. Such solvents include polypropylene glycols (e.g., Dow P2000, PPG-20, 26 and 30), poly(1,2-butylene glycol), poly(2,3-butylene glycol), poly(norbornane oxide glycol), poly(styrene oxide glycol), poly(phenylglycidyl ether glycol), poly(isobutylglycidyl ether glycol), poly(methylglycidyl ether glycol), phenoxypropylene glycol, butoxypropylene glycol (PPG-14 butyl ether), polypropylene glycol butyl ether (PPG-18 butyl ether), polyoxypropylene n-butyl ether, polytetramethylene ether glycol, poly(tetrahydrofuran), poly(ethyl vinyl ether), poly(isobutyl vinyl ether), poly(diallyl ether), polyoxypropylene (30) trimethylpropanetriol, poly(propylene oxide (10)/phenylglycidyl ether (10) glycol], and similar solvents known to the art.

As indicated, a number of otherwise potent organic solvents having an aqueous solubility of less than approximately 0.05 weight percent, and organic solvents having an aqueous solubility in excess of approximately 6 weight percent such as propylene glycol monomethyl ether acetate (aq. sol. 16.5 wt.%), ethylene glycol diacetate (aq. sol. 14.3 wt.%), propylene carbonate (aq. sol. 19.6 wt.%) and N-methyl pyrrolidone (infinite aq. sol.) are not useful in the practice of the invention.

10 In formulating the stable, aqueous cleaner/degreaser emulsion compositions of the invention, an organic solvent meeting the required criteria is combined with a solubilizing additive and water. The solubilizing additive consists of from approximately 0.1 to approximately 100 weight percent of a surfactant and from 0 to approximately 99.9 weight percent of a coupler and, as stated, the solubilizing additive is present in the formulated compositions in an amount insufficient to solubilize all of the total organic solvent content but sufficient to 20 emulsify the unsolubilized portion of the total organic solvent content. The amount of solubilizing additive (surfactant or surfactant plus coupler) required to accomplish this objective will vary depending upon its solubilizing efficacy and upon the particular organic 25 solvent employed; it can readily be determined by simple experimentation in each instance. In general, it is desirable to formulate the emulsion compositions of the invention with as little of the solubilizing additive as possible while achieving the desired solubilization and 30 emulsification of the organic solvent stated above since emulsions so formed will tend to remain in emulsion form even upon being diluted many times with water.

Further, it has been found that the best results are achieved when the emulsion compositions are formulated with organic solvents whose aqueous solubility is between approximately 0.05 and approximately 2.5 weight percent.

5 Also, it has been found that when an organic solvent is employed having a water solubility in the upper portion of the overall range 0.05 to 6 weight percent, it is preferable to utilize a solubilizing additive which is a relatively better emulsifying agent than a solubilizing

10 agent for the organic solvent. On the other hand, when employing an organic solvent whose solubility is in the lower portion of the overall range (e.g., 0.05 to 2.5 weight percent), it is preferable to use a solubilizing agent (such as dodecylbenzenesulfonic acid) which is a

15 relatively better solubilizing agent than an emulsifying agent for the organic solvent of limited aqueous solubility.

The solubilizing additive used in the practice of the invention may consist of one or more compatible surfactants or surfactant(s) in combination with a coupler. As used

20 herein, the term "coupler" is intended to mean a hydrotrope or a substance that increases the solubility in water of another material which is only partially water soluble, such as organic solvents or surfactants. In some instances, the use of a surfactant alone will suffice to

25 achieve the desired solubilization and emulsification of the organic solvent component while in other instances the use of a surfactant or compatible surfactant blend in combination with a coupler may be utilized to achieve the desired dual function of the solubilizing additive

30 component. Whether or not a surfactant alone or the combination of a surfactant and coupler is to be used is dependent upon the particular organic solvent and surfactant employed and can readily be determined in each particular case by simple experimentation.

The surfactants employed in the practice of this invention may be nonionic, anionic, cationic or amphoteric in character. The use of nonionic surfactants is generally preferred to avoid the formation or presence of ionic surfactant salts which tend to break emulsions. Preferred nonionic surfactants include alkylphenoxypoly(ethenoxy) alkanols, alkoxypoly(ethenoxy)alkanols and fatty acid alkanolamides. Specific illustrative nonionic surfactants useful in the practice of the invention include octylphenoxypoly(ethyleneoxy)(4)ethanol, nonylphenoxypoly(ethyleneoxy)(5)ethanol, dodecylphenoxypoly(ethyleneoxy)(8)ethanol, polyoxyethylene (7) lauryl alcohol, polyoxyethylene (4) tridecyl alcohol, lauryloxypoly(ethyleneoxy)(8)ethyl methyl ether, undecylthiopoly(ethyleneoxy)(6)ethanol, methoxypoly(oxyethylene(10)/(oxypropylene(20))-2-propanol block copolymer, nonyloxypoly(propyleneoxy)(4)/(ethyleneoxy)(10)ethanol, dodecyl polyglycoside, polyoxyethylene (9) monolaurate, polyoxyethylene (8) monoundecanoate, polyoxyethylene (20) sorbitan monostearate, polyoxyethylene (18) sorbitol monotallate, sucrose monolaurate, lauryldimethylamine oxide, myristyldimethylamine oxide, lauramidopropyl-N,N-dimethylamine oxide, 1:1 lauric diethanolamide, 1:1 coconut diethanolamide, polyoxyethylene(6)lauramide, 1:1 soya diethanolamidopoly-(ethyleneoxy)(8) ethanol, 1:1 coconut diethanolamide, "modified", and 1:1 coconut diethanolamide, "long chain modified". The fatty acid alkanolamides are a class of nonionic surfactants derived from a 1:1 or 2:1 molar reaction between alkanolamines such as diethanolamine and varying chain length fatty acids such as stearic or oleic acid. For use in the present invention, the fatty acid alkanolamides resulting from a 1:1 catalyzed reaction between an alkanolamine and a fatty acid (known to those

- skilled in the art as "superamides") are preferred since these predominantly consist of the desired nonionic dialkanolamide without appreciable amounts of ionic amine soaps. Among the illustrative fatty acid alkanolamides
- 5 (with their respective molar ratios) which may be used may be mentioned soyamide diethanolamide (1:1) (Mackamide S, McIntyre Group Ltd., Chicago, Illinois), linoleamide diethanolamide (1:1) (Monamid 15-70W, Mona Industries, Inc., Paterson, New Jersey), oleamide diethanolamide (1:1)
- 10 (Clindrol 100-0, and Product WRS 1-66, Clintwood Chemical Company, Chicago, Illinois), ricinoleamide diethanolamide (1:1) (Mackamide R, McIntyre Group Ltd.) isostearamide diethanolamide (1:1) (Monamid 150-IS, Mona Industries, Inc. and Mackamide ISA, McIntyre Group Ltd.), oleamide
- 15 diethanolamide (2:1) (Mackamide O, McIntyre Group Ltd.), soyamide diethanolamide (2:1) (Mackamide SD, McIntyre Group Ltd.), and tall oil diethanolamide (1:1). In addition to those specifically listed above, other known nonionic surfactants may likewise be used.
- 20 Illustrative anionic surfactants for use in the invention include dodecylbenzene sulfonic acid, monoethanolamine dodecylbenzenesulfonate, sodium dodecylbenzene sulfonate, potassium dodecylbenzene sulfonate, triethanolamine dodecylbenzene sulfonate,
- 25 morpholinium dodecylbenzene sulfonate, ammonium dodecylbenzene sulfonate, isopropylamine dodecylbenzene sulfonate, sodium tridecylbenzene sulfonate, sodium dinonylbenzene sulfonate, potassium didodecylbenzene sulfonate, dodecyl diphenyloxide disulfonic acid, sodium
- 30 dodecyl diphenyloxide disulfonate, isopropylamine decyl diphenyloxide disulfonate, sodium hexadecyl-oxypoly(ethyleneoxy)(10)ethyl sulfonate, potassium octylphenoxypoly(ethyleneoxy)(9)ethyl sulfonate, sodium alpha C<sub>12-14</sub> olefin sulfonate, sodium hexadecane-1

sulfonate, sodium ethyl oleate sulfonate, potassium octadecenyl-succinate, sodium oleate, potassium laurate, triethanolamine myristate, morpholinium tallate, potassium tallate, sodium lauryl sulfate, diethanolamine lauryl sulfate, sodium laureth (3) sulfate, ammonium laureth (2) sulfate, sodium nonylphenoxy poly(ethyleneoxy)(4) sulfate, sodium diisobutylsulfosuccinate, disodium laurylsulfosuccinate, tetrasodium N-laurylsulfosuccinimate, sodium decyloxypoly(ethyl-eneoxy(5)methyl)carboxylate, sodium octylphenoxy poly(ethyl-eneoxy(8)methyl)carboxylate, sodium mono decyloxypoly(ethyl-eneoxy)(4)phosphate, sodium didecyloxypoly(ethyleneoxy)-(6)phosphate, and potassium mono/di octylphenoxy poly(ethyl-eneoxy)(9)phosphate. Other anionic surfactants known in the art may also be employed.

Illustrative useful cationic surfactants include a mixture of n-alkyl (C<sub>12</sub> 50%, C<sub>14</sub> 30%, C<sub>16</sub> 17%, C<sub>18</sub> 3%) dimethyl ethylbenzyl ammonium chlorides, hexadecyltrimethyl-ammonium methosulfate, didecyldimethylammonium bromide and a mixture of n-alkyl (68% C<sub>12</sub>, 32% C<sub>14</sub>) dimethyl benzyl ammonium chlorides. Similarly useful amphoteric surfactants include cocamidopropyl betaine, sodium palmitoyloamphopropionate, N-coco beta-aminopropionic acid, disodium N-lauryliminodipropionate, sodium coco imidazoline amphoglycinate and coco betaine. Other cationic and amphoteric surfactants known to the art may also be utilized.

As mentioned, the preferred surfactants for use in the practice of the invention are the alkylphenoxy poly(ethenoxy) alkanol and fatty acid alkanolamide nonionic surfactants.

The couplers which may be utilized in the practice of the invention include sodium benzene sulfonate, sodium toluene sulfonate, sodium xylene sulfonate, potassium ethylbenzene sulfonate, sodium cumene sulfonate, sodium

octane-1-sulfonate, potassium dimethylnaphthalene sulfonate, ammonium xylene sulfonate, sodium n-hexyl diphenyoxide disulfonate, sodium 2-ethylhexyl sulfate, ammonium n-butoxyethyl sulfate, sodium 2-ethylhexanoate, sodium pelargonate, sodium n-butoxymethyl carboxylate, potassium mono/di phenoxyethyl phosphate, sodium mono/di n-butoxyethyl phosphate, triethanolamine trimethylolpropane phosphate, sodium capryloamphopropionate, disodium capryloiminodipropionate, sodium isodecyloxypropyliminodipropionate, sodium caproimidazoline amphoglycinate, and caprylamide DEA/capramide DEA. Certain water-soluble solvents known to the art as couplers such as propylene glycol ethers (e.g. tripropyleneglycol monomethyl ether) can be used in the practice of the invention. Additional couplers or hydrotropes known to the art may also be utilized.

In regard to the solubilizing additive component of the emulsion compositions of the invention, it will be understood that one or more surfactants from one or more compatible classes of surfactants may be employed or utilized in a mixed solubilizing surfactant system. For example, a combination of compatible anionic and/or nonionic surfactants may be employed. Likewise, a combination of compatible couplers may also be used as may a combination of one or more compatible surfactants from different classes of surfactants together with one or more couplers. Thus, one may use a combination of blended surfactants and couplers to achieve the desired solvent solubilization and emulsification. The compatibility of the various surfactants and of the various couplers with each other and in combination can be readily determined by simple experimentation. Similarly, a mixture of the sparingly soluble organic solvents may be employed in formulating the emulsion compositions of the invention.

In addition to the sparingly water soluble organic solvent and solubilizing additive components of the emulsion compositions of the invention, a viscifying thickener or thickening agent may be incorporated to  
5 improve the long term stability of the emulsion compositions.

Thus, thickened emulsion compositions often retard or totally prevent droplet coalescence, overcome phase separation caused by settling or rising droplet mobility  
10 tendencies, and often ameliorate the emulsion destabilizing effects of certain ionic components present in an emulsion composition. The judicious employment of one or more thickening agents may, in fact, allow the propitious use of ionic, but otherwise emulsion destabilizing, solubilizing  
15 additives in the practice of this invention.

Excessive foaming may occur when certain compositions, viscified with thickeners, are agitated to the extent that accumulating air bubbles are trapped in the emulsion. Should this occur, or likely occur, the use of suitable  
20 defoamers (e.g., perfluoroalkyl phosphate esters or silicone) or antifoaming agents may need to be incorporated into the emulsion compositions.

Among the viscifying thickeners useful in the practice of the invention may be mentioned acrylic  
25 acid/alkyl methacrylate copolymers, carboxy acrylic polymers, guar gums, xanthan gums, hydroxyethyl cellulose, hydroxypropyl cellulose, carboxymethyl cellulose, bentonite clays, organically modified magnesium aluminum silicates, polyethylene glycols, polyethylene oxide, fumed silica,  
30 polyacrylic acid crosslinked with polyalkenyl polyethers, polyacrylamide, polyvinyl alcohol, poly(methylvinyl ether/maleic) anhydride and sodium alginate. Other viscifying thickeners known to the art may also be used. When the viscifying thickener is anionic in nature such

as the thickener acrylic acid/alkyl methacrylate copolymer (Acrysol ICS-1 by Rohm & Haas), an amine such as triethanolamine or other neutralizing base should also be incorporated to neutralize any free carboxylic acid groups and thereby cause enhanced thickening. With the use of nonionic thickeners such as guar gums, hydroxyethyl cellulose and hydroxypropyl cellulose, the inclusion of such an amine is unnecessary.

Various optional adjuvants can also be incorporated into the emulsion compositions of the invention. These include chelants such as the sodium salts of ethylenediaminetetraacetic acid (Hampene 100 or Versene 100), defoamers and foam controlling agents, fragrances, dyes, preservatives, lubricants, emollients, pH adjustants, dispersants, abrasives, anti-corrosion additives and anti-rust additives. To prevent flash rusting when the emulsion compositions are used to clean and/or degrease metal surfaces, an anti flash-rusting additive such as an alkanolamine (e.g., monoethanolamine) or sodium nitrite may be incorporated. In general, it is preferred that the compositions be formulated to have a pH within a range of about 6.5-10 so as to be gentle to the hands and avoid defatting the skin.

The emulsion compositions of the invention may be prepared by combining the various components together under mechanical mixing conditions to form the desired emulsions. Thus, for example, the solubilizing additive may first be dispersed in water with stirring followed by the addition of the sparingly soluble organic solvent with stirring over a period of time to achieve complete emulsification. Other viable, proven techniques involving formation of either O/W or W/O emulsions or emulsion concentrates, optionally followed by phase inversions, may also be employed. In forming emulsions in the form of

lotions or creams for use as hand cleaners, the organic solvent and solubilizing additive components may be pre-emulsified in water with stirring and a thickening agent added to form the final emulsion in semipaste or thickened form.

Upon sufficient dilution with water, the emulsions of the invention will first be transformed into microemulsion form and then into solution form with an accompanying decrease in the degreasing efficacy of the composition as shown by the experimental test data presented hereinafter.

As shown by the working examples set forth hereinafter, the invention may be practiced to prepare emulsion compositions having varying concentrations of components, especially solvent level, depending upon the end use for the emulsions and, thus, emulsion concentrate compositions and ready-to-use strength emulsion compositions can be prepared. In either case, the desired stabilities for the various emulsions of the invention can be achieved by observing the following principles.

Generally speaking, emulsion concentrate compositions (such as described in Examples 2-4 hereinafter) are more susceptible to destabilization (or "breaking") with increasing ionic strength than their less concentrated, more dilute counterparts. For this reason the use of, e.g. ionic surfactants and couplers, ionic builders, and ionic anti-flash rust/anti-corrosion additives, etc. in formulating concentrates must be kept at a minimum or, if possible, wholly avoided or eliminated. This can often be accomplished simply by substituting equivalent nonionic replacements for ionic ones. On the other hand, ready-to-use strength emulsion compositions (such as described in Example 27 hereinafter) can often safely accommodate modest levels of ionic components, additives, etc. (such as solubilizing additives, thickeners, chelants, and anti-flash rust/corrosion additives) without

experiencing serious emulsion destabilization and resultant shelf life shortening. In the latter case thickeners often play an important role in promoting long-term emulsion stability. In any case, in practicing the above  
5 guidelines, the restrictions placed upon the practice of the invention must be strictly adhered to.

The concentration of the aqueous cleaner/degreaser solution, as indicated by the terms "total solids content" and "total actives content" in the working examples  
10 provided hereinafter refers, respectively, to the combined percentages of nonvolatile components and to the sum total of nonaqueous volatile and nonvolatile components.

The following examples illustrate the practice of the invention.

15

Example 1

In the following examples of illustrative cleaner/degreaser emulsion compositions of the present invention, the compositions were subjected as indicated to the definitive, semiquantitative degreasing test method  
20 described below in order to measure their cleaning/degreasing efficacy.

A magnetic stirrer (Fisher Scientific Co., Catalog No. 14-511-1A) provided with a vaned disc magnetic stir bar (7/8" (diameter) x 5/8" (height), 22 mm x 15 mm, Fisher  
25 Scientific Co., Catalog No. 14-511-98C) was used. In each instance, pre-cleaned, borosilicate glass microslides (3" x 1", 1.0 mm thickness) were thinly smeared/rub-on coated with Vaseline brand white petroleum jelly on one side only to a distance of 1.0" from the bottom edge to provide a  
30 1.0" x 1.0" coated area. The test cleaner/degreaser emulsions or solutions were employed at the strength indicated and in an amount sufficient to fill a 50 ml Pyrex

beaker containing the vaned disc magnetic stirrer bar to a level of 40 ml. Each test material and surrounding air were maintained at  $21 \pm 0.5^{\circ}\text{C}$  and the test material stirring rate was determined by a setting of "3" on the stirrer dial of the magnetic stirrer. The stirring disc was positioned off-center to accomodate each microslide, touching neither the beaker walls nor the microslide and rotating freely when in use. The microslide, in each test, rested upright on the beaker bottom, was allowed to lean against the lip of the beaker at an approximately  $75^{\circ}$  angle and was positioned with the Vaseline coated face or area facing upward away from the vaned disc magnetic stirrer bar.

For each test, the beaker containing the stirrer bar was filled to 40 ml. with the test cleaning/degreasing emulsion or solution at the indicated concentration, placed atop the magnetic stirrer plate, and positioned off-center to accomodate the glass microslide, and yet allow the vaned disc stirrer bar to rotate or spin freely. The stirrer was turned on, the dial adjusted manually to the "3" stirring rate setting and the Vaseline thin film coated glass microslide was introduced into the test material bath in such a manner that the coated side faced upward and was positioned away from the stirrer bar. The time "0" was noted immediately on a watch or clock with a sweep second hand.

At appropriate time intervals, the glass microslide was briefly removed from the cleaner/degreaser material bath and immediately "read" for "% Vaseline removed from the 1.0" x 1.0" treated area", an objective determination, after which the microslide was immediately returned to the stirred aqueous cleaner/degreaser bath. The duration of the degreasing test is determined by the time needed for complete, 100% removal of the Vaseline film from the glass microslide surface.

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The accuracy of the above-described test method is of the order of  $\pm 5\%$  as determined by replicate run averaging.

Example 2

An aqueous cleaner/degreaser emulsion was prepared  
5 having the following composition:

	<u>Component</u>	<u>Wt. %</u>
	1-Phenoxy-2-propanol (Dowanol PPh)	20.0
10	Isostearamide diethanolamide (1:1) (Monamide 150 IS)	3.0
	Soft H <sub>2</sub> O	<u>177.0</u>
		200.0

The isostearamide diethanolamide and water were stirred until the former was dispersed. The  
15 1-phenoxy-2-propanol solvent was then stirred into the dispersion at room temperature for 45 minutes to achieve complete emulsification. The resulting composition was an intensely bluish/white emulsion having a pH of 8.86, a Brookfield viscosity (LV-#2 spindle, 60 rpm) of 4.0  
20 centipoise, a total solids content (theory) of 1.50%, and a total actives content (theory) of 11.50%. The emulsion exhibited no flash point and was found to be storage stable for greater than five months at room temperature. If forced to slowly separate or oil out, e.g., in freeze/thaw  
25 cycling, the composition is easily redispersed into emulsion form by agitation.

At a 1:5 dilution with water, a bluish/white microemulsion formed. The microemulsion very readily and completely removed the following markings from alkyd

enameled metal surfaces: black, indelible Magic Marker felt pen, blue and black indelible ballpoint pen, #1 hardness pencil, red (waxy) crayon and smeared automotive grease.

- 5       The above-formed microemulsion was subjected to the degreasing test method of Example 1 with the following results:

- 1st attack on greased slide at 1 sec.  
60% removal of grease at 10 sec.  
10       100% removal of grease at 17 sec.

### Example 3

Example 2 was repeated in preparing an aqueous cleaner/degreaser emulsion having the following composition:

	<u>Component</u>	<u>Wt.%</u>
15	1-Phenoxy-2-propanol (Dowanol PPh)	20.0
	Isostearamide diethanolamide (1:1) (Monamide 150 IS)	5.0
	Monoethanolamine	0.2
20	Soft H <sub>2</sub> O	<u>174.8</u>
		200.0

- The resulting composition was an intensely bluish/white emulsion having a pH of 10.07, a Brookfield viscosity (LV-#2 spindle, 60 rpm) of 5.5 centipoise, a  
25   total solids content (theory) of 2.50%, and a total actives content (theory) of 12.60%. The emulsion exhibited no flash point and was found to be storage stable for in excess of five months at room temperature. Upon very slight, slow oiling out, the composition was readily  
30   redispersed on shaking.

At a 1:5 dilution with water, a bluish/white microemulsion formed. The microemulsion very easily, readily and completely removed the following markings from alkyd enameled metal surfaces: black, indelible Magic  
5 Marker felt pen, blue and black indelible ballpoint pen, #1 hardness pencil, red (waxy) crayon and smeared automotive grease.

The above-formed microemulsion was subjected to the degreasing test method of Example 1 with the following  
10 results:

1st attack on greased slide at 1 sec.

70-75% removal of grease at 10 sec.

100% removal of grease at 14 sec.

#### Example 4

15 Example 2 was repeated in preparing an aqueous cleaner/degreaser emulsion having the following composition:

	<u>Component</u>	<u>Wt. %</u>
	1-Phenoxy-2-propanol (Dowanol PPh)	20.0
20	Isostearamide diethanolamide (1:1) (Monamide 150 IS)	6.0
	Monoethanolamine	0.2
	Soft H <sub>2</sub> O	<u>173.8</u>
		200.0

25 The resulting composition was an intensely bluish/white emulsion having a pH of 9.76, a Brookfield viscosity (LV-#2 spindle, 60 rpm) of 6.5 centipoise, a total solids content (theory) of 3.00%, and a total actives content (theory) of 13.10%. The emulsion exhibited no

flash point and was found to have excellent storage stability for at least two months at room temperature with no separation occurring.

At a 1:5 dilution with water, a bluish/white  
5 microemulsion formed. The microemulsion very easily, readily and completely removed the following workings from alkyd enameled metal surfaces: black, indelible Magic Marker felt pen, blue and black indelible ballpoint pen, #1 hardness pencil, red (waxy) crayon and smeared automotive  
10 grease.

The above microemulsion was subjected to the degreasing test method of Example 1 with the following results:

1st attack on greased slide at 1 sec.  
15 60% removal of grease at 10 sec.  
100% removal of grease at 18 sec.

#### Example 5

Example 2 was repeated in preparing an aqueous cleaner/degreaser emulsion having the following composition:

20	<u>Component</u>	<u>Wt.%</u>
	1-Phenoxy-2-propanol (Dowanol PPh)	20.0
	Isostearamide diethanolamide (1:1) (Monamide 150 IS)	7.0
25	Monoethanolamine	0.2
	Soft H <sub>2</sub> O	<u>172.8</u>
		200.0

The resulting composition was an intensely bluish/white emulsion having a pH of 9.72, a Brookfield viscosity (LV-#2 spindle, 60 rpm) of 4.8 centipoise, a total solids content (theory) of 3.5%, and a total actives content (theory) of 13.6%. The emulsion exhibited no flash point and was found to have excellent storage stability for at least two months at room temperature with no separation occurring.

At a 1:5 dilution with water, a bluish/white microemulsion formed. The microemulsion very quickly and completely removed all of the markings set forth in Examples 2-4 from alkyd enameled metal surfaces.

The microemulsion was subjected to the degreasing test method of Example 1 with the following results:

1st attack on greased slide at 1 sec.  
75-80% removal of grease at 10 sec.  
100% removal of grease at 13 sec.

#### Example 6

Example 2 was repeated in preparing an aqueous cleaner/degreaser emulsion having the following composition:

	<u>Component</u>	<u>Wt. %</u>
	1-Phenoxy-2-propanol (Dowanol PPh)	20.0
25	Isostearamide diethanolamide (1:1) (Monamide 150 IS)	3.0
	Lauramide diethanolamide (1:1) (Superamide)(Clindrol LL-136)	3.0
	Monoethanolamine	0.2
	Soft H <sub>2</sub> O	<u>173.8</u>
30		200.0

The resulting composition was a bluish/white emulsion having a pH of 9.92, a Brookfield viscosity (LV-#2 spindle, 60 rpm) of 4.0 centipoise, a total solids content (theory) of 3.0%, and a total actives content (theory) of 13.1%.

- 5 The emulsion exhibited no flash point and was found to have good/excellent storage stability for in excess of two months at room temperature.

At a 1:5 dilution with water, a bluish/white microemulsion formed. The microemulsion very easily and  
10 completely removed all of the markings set forth in Examples 2-4 from alkyd enameled metal surfaces.

The microemulsion was subjected to the degreasing test method of Example 1 with the following results:

- 1st attack on greased slide at 1 sec.  
15 60% removal of grease at 10 sec.  
85% removal of grease at 15 sec.  
100% removal of grease at 17 sec.

#### Example 7

- Example 2 was repeated in preparing an aqueous  
20 cleaner/degreaser emulsion having the following composition:

	<u>Component</u>	<u>Wt. %</u>
	1-Phenoxy-2-propanol (Dowanol PPh)	20.0
25	Ricinoleamide diethanolamide (1:1) (Superamide)(Mackamide R)	7.0
	Monoethanolamine	0.2
	Soft H <sub>2</sub> O	<u>172.8</u>
		200.0

The latter three components were stirred until fully dispersed and the 1-phenoxy-2-propanol was then stirred into the dispersion for one hour to form an emulsion. The resulting composition was a white, colorless emulsion with a slightly bluish cast, having a pH of 9.93, a Brookfield viscosity (LV-#2 spindle, 60 rpm) of 4.6 centipoise, a total solids content (theory) of 3.5%, and a total actives content (theory) of 13.6%. The emulsion exhibited no flash point, and was found to have good storage stability for in excess of two months at room temperature.

At a 1:5 dilution with water, a white to bluish/white emulsion was formed. The emulsion completely removed all of the markings set forth in Examples 2-4 from alkyd enameled metal surfaces.

The emulsion was subjected to the degreasing test method of Example 1 with the following results:

1st attack on greased slide at 1 sec.  
75% removal of grease at 10 sec.  
100% removal of grease at 12 sec.

20

Example 8

Example 2 was repeated in preparing an aqueous cleaner/degreaser emulsion having the following composition:

	<u>Component</u>	<u>Wt. %</u>
25	1-Phenoxy-2-propanol (Dowanol PPh)	20.0
	Oleamide diethanolamide (1:1) (Superamide)(Mackamide MO)	6.0
	Monoethanolamine	0.2
	Soft H <sub>2</sub> O	<u>173.8</u>
30		200.0

The resulting composition was a white emulsion having a pH of 10.21, a Brookfield viscosity (LV-#2 spindle, 60 rpm) of 4.5 centipoise, a total solids content (theory) of 3.0%, and a total actives content (theory) of 13.1%. The emulsion exhibited no flash point, and was found to have good/excellent storage stability for two months at room temperature.

At a 1:5 dilution with water, a white colored emulsion was formed. The emulsion smudged but completely removed all of the markings set forth in Examples 2-4 from alkyd enameled metal surfaces.

The emulsion was subjected to the degreasing test method of Example 1 with the following results:

1st attack on greased slide at 1 sec.  
70-75% removal of grease at 10 sec.  
100% removal of grease at 14 sec.

#### Example 9

Example 2 was repeated in preparing an aqueous cleaner/degreaser emulsion having the following composition:

20	<u>Component</u>	<u>Wt. %</u>
	1-Phenoxy-2-propanol (Dowanol PPh)	20.0
	Isostearamide diethanolamide (1:1) (Mackamide ISA)	7.0
25	Monoethanolamine	0.2
	Soft H <sub>2</sub> O	<u>172.8</u>
		200.0

The resulting composition was an intensely bluish/white emulsion having a pH of 9.79, a Brookfield viscosity (LV-#2 spindle, 60 rpm) of 6.2 centipoise, a total solids content (theory) of 3.5%, and a total actives content (theory) of 13.6%. The emulsion exhibited no flash point, and was found to be very stable over extended periods at room temperature.

At a 1:5 dilution with water, a bluish-white microemulsion was formed. The microemulsion readily and completely removed all of the markings set forth in Examples 2-4 from alkyd enameled metal surfaces.

The microemulsion was subjected to the degreasing test method set forth in Example 1 with the following results:

1st attack on greased slide at 1 sec.  
70% removal of grease at 10 sec.  
100% removal of grease at 15 sec.

#### Example 10

Example 2 was repeated in preparing an aqueous cleaner/degreaser emulsion having the following composition:

20	<u>Component</u>	<u>Wt. %</u>
	1-Phenoxy-2-propanol (Dowanol PPh)	20.0
	Linoleamide diethanolamide (1:1) (soyamide DEA- 25 Clindrol LT-15-73-1)	7.0
	Monoethanolamine	0.2
	Soft H <sub>2</sub> O	<u>172.8</u>
		200.0

The resulting composition was an intensely white emulsion with a slight bluish cast and having a pH of 10.42, a Brookfield viscosity (LV-#2, spindle, 60 rpm) of 5.0 centipoise, a total solids content (theory) of 3.5%, and a total actives content (theory) of 13.6%. The emulsion was quite stable at room temperature for 1-2 months.

At a 1:5 dilution with water, a bluish/white microemulsion was formed. The microemulsion readily and completely removed all of the markings set forth in Examples 2-4 from alkyd enameled metal surfaces.

The microemulsion was subjected to the degreasing test method of Example 1 with the following results:

1st attack on greased slide at 1 sec.  
100% removal of grease at 13 sec.

#### Example 11

Example 2 was repeated in preparing an aqueous cleaner/degreaser emulsion having the following composition:

	<u>Component</u>	<u>Wt. %</u>
20	1-Phenoxy-2-propanol (Dowanol PPh)	30.0
	Isostearamide diethanolamide (1:1) (Mackamide ISA)	10.0
	Monoethanolamine	0.3
25	Soft H <sub>2</sub> O	<u>159.7</u>
		200.0

The resulting composition was an intensely bluish/white emulsion having a pH of 9.63, a Brookfield viscosity (LV-#2 spindle, 60 rpm) of 7.0 centipoise, a

total solids content (theory) of 5.0%, and a total actives content (theory) of 20.15%. The emulsion exhibited excellent stability over an extended period at room temperature.

5        At a 1:8 dilution with water, a bluish/white microemulsion was formed which had a 1.67% concentration of 1-phenoxy-2-propanol. The microemulsion very easily and completely removed all of the markings set forth in Examples 2-4 from alkyd enameled metal surfaces.

10       The microemulsion was subjected to the degreasing test method of Example 1 with the following results:

1st attack on greased slide at 1 sec.

70-75% removal of grease at 10 sec.

100% removal of grease at 15 sec.

15

Example 12

Example 2 was repeated in preparing an aqueous cleaner/degreaser emulsion having the following composition:

	<u>Component</u>	<u>Wt. %</u>
20	1-Phenoxy-2-propanol (Dowanol PPh)	20.0
	Isostearamide diethanolamide (1:1) (Monamid 150-IS)	8.0
	Monoethanolamine	0.2
	Soft H <sub>2</sub> O	<u>171.8</u>
25		200.0

The resulting composition was a very intense bluish/white emulsion having a pH of 9.85, a Brookfield viscosity (LV-#2 spindle, 60 rpm) of 6.5 centipoise, a

total solids content (theory) of 4.0%, and a total actives content (theory) of 14.1%. The emulsion exhibited excellent stability over at least a four month period.

At a 1:5 dilution with water, a bluish to  
 5 bluish/white microemulsion was formed which had a 1.67% concentration of 1-phenoxy-2-propanol. The microemulsion very easily and completely removed all of the markings set forth in Examples 2-4 from alkyd enameled metal surfaces.

The microemulsion was subjected to the degreasing  
 10 test method of Example 1 with the following results:

1st attack on greased slide at 1 sec.  
 40% removal of grease at 10 sec.  
 65-70% removal of grease at 15 sec.  
 100% removal of grease at 22 sec.

15

Example 13

A hand cleaner in the form of a semipaste emulsion was prepared having the following composition:

	<u>Component</u>	<u>Wt. %</u>
20	Polypropylene glycol (Dow P-2000)	30.0
	Linoleamide diethanolamide (1:1) (Soyamide DEA-Clindrol LT-15-73-1)	4.5
25	Acrylic acid/alkyl methacrylate copolymer 30% aqueous (Acrysol ICS-1)	0.2
	Triethanolamine	0.5
	Soft H <sub>2</sub> O	<u>261.0</u>
30		300.0

The polypropylene glycol and linoleamide diethanolamide were pre-emulsified in water with stirring and the Acrysol ICS-1 thickening agent was then added with stirring. The triethanolamine was then added dropwise with stirring to form a semipaste, intensely white emulsion. The emulsion had a pH of 8.22, a Brookfield viscosity (LV-#4 spindle, 6 rpm) of 19,250 centipoise, and a total solids content (theory) of 11.9%.

The emulsion had a very smooth feel and exhibited fair/good removal of oily, greasy soils from hands.

#### Example 14

A hand cleaner in the form of a semipaste emulsion was prepared having the following composition:

	<u>Component</u>	<u>Wt. %</u>
15	1-Phenoxy-2-propanol (Dowanol PPh)	15.0
	Polypropylene glycol (Dow P-2000)	15.0
20	Nonylphenoxy poly(ethyleneoxy) (8.5) ethanol (nonionic surfactant-T-Det N-9.5)	0.3
	Polyacrylic acid crosslinked with polyalkenyl polyether (0.12% aq. Carbopol 940)	265.5
25	Linoleamide diethanolamide (1:1) (Soyamide DEA- Clindrol LT-15-73-1)	4.2
		<hr/> 300.0

The first four components listed were pre-emulsified with stirring, and the linoleamide diethanolamide was added with vigorous stirring to form a semipaste, intensely white

emulsion. The emulsion had a pH of 6.72, a Brookfield viscosity (LV-#4 spindle, 6 rpm) of 23,000 centipoise, a total solids content (theory) of 6.61%, and a total actives content (theory) of 11.61%.

- 5       The emulsion had a smooth feel, excellent rinsing properties, and exhibited excellent, fast removal of oily, greasy soils from hands although somewhat irritating to the skin.

Example 15

- 10       A hand cleaner in the form of a thick, paste/lotion emulsion was prepared having the following composition:

	<u>Component</u>	<u>Wt. %</u>
	1-Phenoxy-2-propanol (Dowanol PPh)	1.0
15	Polypropylene glycol (Dow P-2000)	9.0
	Mineral Oil (Viscosity, 165 centipoise)	9.0
20	Linoleamide diethanolamide (1:1) (Soyamide DEA- Clindrol LT-15-73-1)	2.0
	Soft H <sub>2</sub> O	78.0
25	Acrylic acid/alkyl methacrylate copolymer, 30% aqueous (Acrysol ICS-1)	1.0
		<hr/> 100.0

- 30       All of the components except the Acrysol ICS-1 thickening agent were pre-emulsified with stirring, and the thickening agent was then added slowly with vigorous

stirring. The resulting composition was an intensely bluish/white emulsion in the form of a thick, paste/lotion. The emulsion had a pH of 7.62, a Brookfield viscosity (LV-#4 spindle, 6 rpm) of 54,000 centipoise, a total solids content (theory) of 20.3%, and a total actives content (theory) of 21.3%.

The emulsion had a smooth feel, good rinsing characteristics, and exhibited good/very good removal of oily and greasy soils from hands.

10

Example 16

Example 15 was repeated in preparing a semipaste emulsion having the following composition:

	<u>Component</u>	<u>Wt.%</u>
15	1-Phenoxy-2-propanol (Dowanol PPh)	1.0
	2-Phenoxyethanol (Dowanol EPh)	1.0
20	Tripropyleneglycol monomethyl ether (Dowanol TPM)	1.0
	Polypropylene glycol (Dow P-2000)	9.0
	Mineral oil (Viscosity, 165 centipoise)	9.0
25	Linoleamide diethanolamide (1:1) (Soyamide DEA-Clindrol LT-15-73-1)	2.0
	Soft H <sub>2</sub> O	75.6
30	Acrylic acid/alkyl methacrylate copolymer, 30% aqueous (Acrysol ICS-1)	1.4
		<hr/> 100.0

The resulting composition was an intensely bluish/white emulsion in the form of a semipaste. The emulsion had a pH of 7.02, a Brookfield viscosity (LV-#4 spindle, 6 rpm) of 28,000 centipoise, a total solids content (theory) of 20.4%, and a total actives content (theory) of 23.42%.

The emulsion had a very smooth feel, excellent rinsability characteristics, and exhibited very good removal of oily and greasy soils from hands with a low level of irritation to the skin.

#### Example 17

Example 15 was repeated in preparing a thick lotion emulsion having the following composition:

	<u>Component</u>	<u>Wt. %</u>
15	Polypropylene glycol (Dow P-2000)	9.0
	Mineral oil (Viscosity, 165 centipoise)	9.0
20	Linoleamide diethanolamide (1:1) (Soyamide DEA-Clindrol LT-15-73-1)	5.0
	Soft H <sub>2</sub> O	76.1
	Acrylic acid/alkyl methacrylate copolymer, 30% aqueous (Acrysol ICS-1)	0.9
25		
		<hr/> 100.0

The resulting composition was an intensely white emulsion in the form of a thick lotion. The emulsion had a pH of 9.33, a Brookfield viscosity (LV-#4 spindle, 6 rpm) of 24,400 centipoise, and a total solids content (theory) of 23.27%.

The emulsion had a very smooth feel, excellent rinsability characteristics, and exhibited excellent removal of oily and greasy soilants from hands.

Example 18

- 5        Example 15 was repeated in preparing a cream/lotion emulsion having the following composition:

	<u>Component</u>	<u>Wt. %</u>
	1-Phenoxy-2-propanol (Dowanol PPh)	1.0
10	Polypropylene glycol (Dow P-2000)	15.0
	Nonylphenoxy poly(ethyleneoxy) (7) ethanol (nonionic surfactant-T-Det N-8)	3.0
15	Linoleamide diethanolamide (1:1) (Soyamide DEA-Clindrol LT-15-73-1)	2.0
	Soft H <sub>2</sub> O	78.0
20	Acrylic acid/alkyl methacrylate copolymer, 30% aqueous (Acrysol ICS-1)	1.0
		<hr/> 100.0

- 25        The resulting composition was an intensely white emulsion in the form of a cream/lotion. The emulsion had a pH of 8.07, a Brookfield viscosity (LV-#3 spindle, 12 rpm) of 4300 centipoise, a total solids content (theory) of 20.3%, and a total actives content (theory) of 21.3%.

The emulsion had a very smooth feel, excellent rinsability characteristics, and exhibited excellent removal of oily and greasy soilants from hands. In addition, the emulsion is fully biodegradable.

5

Example 19

An emulsion was prepared having the following composition:

	<u>Component</u>	<u>Wt.%</u>
10	1-Phenoxy-2-propanol (Dowanol PPh)	20.0
	Nonylphenoxypoly(ethyleneoxy) (8) ethanol (nonionic surfactant-T-Det N-8)	4.0
15	Acrylic acid/alkyl methacrylate copolymer, 30% aqueous (Acrysol ICS-1)	1.60
	Triethanolamine	0.7
	Soft H <sub>2</sub> O	173.7
20		<u>200.0</u>

The water was added with stirring to the 1-phenoxy-2-propanol and nonionic surfactant components. The Acrysol ICS-1 thickening agent was then added with continued stirring, followed by the dropwise addition of the triethanolamine with stirring. The resulting composition was a white, creamy emulsion having a pH of 7.82, a Brookfield viscosity (LV-#2 spindle, 30 rpm) of 120 centipoise, a total solids content (theory) of 2.59%, and a total actives content (theory) of 12.59%.

At both a 1:4 and a 1:5 dilution with water, diluted emulsions were formed which easily removed black Magic Marker markings from alkyd enameled metal surfaces.

At a 1:4 dilution with water, the resulting  
5 emulsion was subjected to the degreasing test method of Example 1 with the following results:

1st attack on greased slide at 3 sec.  
55-60% removal of grease at 10 sec.  
100% removal of grease at 15 sec.

10 At a 1:5 dilution with water, the resulting emulsion was subjected to the degreasing test method of Example 1 with the following results:

1st attack on greased slide at 3 sec.  
55-60% removal of grease at 10 sec.  
15 100% removal of grease at 20 sec.

#### Example 20

Example 19 was repeated in preparing an emulsion having the following composition:

	<u>Component</u>	<u>Wt. %</u>
20	1-Phenoxy-2-propanol (Dowanol PPh)	20.0
	Nonylphenoxy poly(ethyleneoxy) (8.5) ethanol (nonionic surfactant-T-Det N-9.5)	3.0
25	Triethanolamine	0.7
	Soft H <sub>2</sub> O containing 0.06% polyacrylic acid crosslinked with polyalkenyl polyether (Carbopol 940 thickener)	176.3
30		<hr/> 200.0

The resulting composition was a white, creamy emulsion having a pH of 8.42, a Brookfield viscosity (LV-#2 spindle, 30 rpm) of 217 centipoise, a total solids content (theory) of 1.75%, and a total actives content (theory) of  
5 11.75%.

At a 1:5 dilution with water, an emulsion resulted which easily removed black Magic Marker markings from an alkyd enameled metal surface. The emulsion was subjected to the degreasing test method of Example 1 with the  
10 following results:

1st attack on greased slide at 1 sec.  
(almost instantaneous)  
100% removal of grease at 9 sec.

At a 1:10 dilution with water, a slightly hazy  
15 emulsion-solution was formed which was rather ineffective in removing black Magic Marker markings from an alkyd enameled metal surface. The emulsion-solution was subjected to the degreasing test method of Example 1 with the following results:

20 1st attack on greased slide at 3 sec.  
60% removal of grease at 15 sec.  
100% removal of grease at 25 sec.

At a 1:20 dilution with water, a clear solution was formed which was totally ineffective in removing black  
25 Magic Marker markings from an alkyd enameled metal surface. The solution was subjected to the degreasing test method of Example 1 with the following results:

1st attack on greased slide at 15 sec.  
10-15% removal of grease at 1.0 min.  
30 25% removal of grease at 2.0 min.

40

- 45% removal of grease at 30 min.  
 60% removal of grease at 4.0 min.  
 70% removal of grease at 5.0 min.  
 75-80% removal of grease at 6.0 min.  
 5 85% removal of grease at 7.0 min.  
 90-95% removal of grease at 9.0 min.  
 100% removal of grease at 10.0 min.

The marked change in degreasing efficacy (rates) between the 1:10 and 1:20 composition dilution ratios can, in part, be attributable to the change from emulsion to solution form of the cleaner/degreaser.

#### Example 21

Example 19 was repeated in preparing an emulsion having the following composition:

15	<u>Component</u>	<u>Wt. %</u>
	1-Phenoxy-2-propanol (Dowanol PPh)	20.0
	Octylphenol ethoxylate (5E.O.) (Triton X-45)	3.0
20	Triethanolamine	0.5
	Soft H <sub>2</sub> O containing 0.06% polyacrylic acid crosslinked with polyalkenyl polyether (Carbopol 940 thickener)	176.5
25		<u>200.0</u>

The resulting composition was a white, creamy emulsion having a pH of 8.39, a Brookfield viscosity (LV-#2 spindle, 30 rpm) of 162 centipoise, a total solids content (theory) of 1.75%, and a total actives content (theory) of 11.75%.

At a 1:5 dilution with water, an emulsion resulted which was subjected to the degreasing test method of Example 1 with the following results:

- 5        1st attack on greased slide at 5 sec.  
         35-40% removal of grease at 10 sec.  
         80% removal of grease at 20 sec.  
         100% removal of grease at 25 sec.

- 10       At a 1:10 dilution with water, an emulsion resulted which was subjected to the degreasing test method of Example 1 with the following results:

         1st attack on greased slide at 10 sec.  
         40% removal of grease at 20 sec.  
         75% removal of grease at 30 sec.  
         100% removal of grease at 45 sec.

- 15       At a 1:20 dilution with water, a hazy emulsion-solution resulted which was subjected to the degreasing test method of Example 1 with the following results:

- 20       1st attack on greased slide at 20 sec.  
         10% removal of grease at 1 min.  
         20-25% removal of grease at 2 min.  
         40% removal of grease at 3 min.  
         65% removal of grease at 4.25 min.  
         85-90% removal of grease at 6 min.  
25       100% removal of grease at 7.5 min.

Example 22

Example 19 was repeated in preparing an emulsion having the following composition:

	<u>Component</u>	<u>Wt. %</u>
5	1-Phenoxy-2-propanol (Dowanol PPh)	30.0
	Dodecylbenzenesulfonic acid	0.6
	Acrylic acid/alkyl methacrylate copolymer,	2.2
10	30% aqueous (Acrysol ICS-1)	
	Triethanolamine	1.4
	Soft H <sub>2</sub> O	165.8
15		<hr/> 200.0

The resulting composition was an intense white, creamy emulsion having a pH of 7.67, a Brookfield viscosity (LV-#2 spindle, 30 rpm) of 230 centipoise, a total solids content (theory) of 1.33% and a total actives content (theory) of 16.33%.

At a 1:5 dilution with water, an emulsion resulted which very easily removed black Magic Marker markings from an alkyd enameled metal surface. The emulsion was subjected to the degreasing test method of Example 1 with the following results:

1st attack on greased slide at 1 sec.  
(almost instantaneous)  
100% removal of grease at 7 sec.

At a dilution of 1:10 with water, a very slight emulsion or almost hazy solution resulted which was only moderately effective in removing black Magic Marker

markings from an alkyd enameled metal surface. The emulsion or solution was subjected to the degreasing test method of Example 1 with the following results:

- 5           1st attack on greased slide at 1+ sec.  
          100% removal of grease at 12 sec.

- 10           At a dilution of 1:20 with water, a clear solution was formed which was wholly ineffective in removing black Magic Marker markings from an alkyd enameled metal surface. The solution was subjected to the degreasing test method of Example 1 with the following results:

1st attack on greased slide at 5 sec.  
40% removal of grease at 15 sec.  
75% removal of grease at 30 sec.  
100% removal of grease at 45 sec.

15

Example 23

Example 19 was repeated in preparing an emulsion having the following composition:

	<u>Component</u>	<u>Wt. %</u>
20	1-Phenoxy-2-propanol (Dowanol PPh)	20.0
	Octylphenol ethoxylate (7-8 E.O.) (Triton X-114)	4.0
	Triethanolamine	1.0
	Soft H <sub>2</sub> O	172.0
25	Acrylic acid/alkyl methacrylate copolymer, 30% aqueous (Acrysol ICS-1)	3.0
		<hr/> 200.0

All of the components except the Acrysol ICS-1 thickening agent were pre-emulsified with a high-speed, motor driven, 3-bladed propeller for 3 minutes, and the Acrysol ICS-1 was then added very slowly with vigorous stirring to provide immediate thickening. The resulting composition was an intensely bluish/white emulsion in the form of a thick lotion or semipaste having a pH of 7.88, a Brookfield viscosity (LV-#4 spindle, 12 rpm) of 8600 centipoise, a total solids content (theory) of 2.8%, and a total actives content (theory) of 12.8%.

At a 1:5 dilution with water, a bluish/white microemulsion formed which very easily and fully removed the following markings from alkyd enameled metal surfaces: black Magic Marker felt pen, blue and black indelible ballpoint pen, #1 hardness pencil and red (waxy) crayon.

The microemulsion was subjected to the degreasing test method of Example 1 with the following results:

1st attack on greased slide at 1 sec.  
60% removal of grease at 10 sec.  
100% removal of grease at 20 sec.

#### Example 24

Example 23 was repeated in preparing an emulsion having the following composition:

	<u>Component</u>	<u>Wt. %</u>
25	1-Phenoxy-2-propanol (Dowanol PPh)	20.0
	C <sub>9</sub> -C <sub>11</sub> alkanol/2.5 E.O. condensate (Neodol 91-2.5)	4.0
	Triethanolamine	1.0

45

	Soft H <sub>2</sub> O	172.0
	Acrylic acid/alkyl methacrylate copolymer, 30% aqueous (Acrysol 5 ICS-1)	3.0
		<hr/> 200.0

The resulting composition was an intensely bluish-white emulsion having a pH of 8.27, a Brookfield viscosity (LV-#3 spindle, 12 rpm) of 3650 centipoise, a  
10 total solids content (theory) of 2.8%, and a total actives content (theory) of 12.8%.

At a 1:5 dilution with water, a bluish/white microemulsion formed which very quickly, easily and totally removed the following markings from alkyd enameled metal  
15 surfaces: black Magic Marker felt pen, blue and black indelible ballpoint pen, #1 hardness pencil, red (waxy) crayon, and automotive grease smearings.

The microemulsion was subjected to the degreasing test method of Example 1 with the following results:

20 1st attack on greased slide at less than 1 sec.  
100% removal of grease at 15 sec.

#### Example 25

An aqueous cleaner/degreaser emulsion in the form of an aerosol formulation was prepared having the following  
25 composition:

	<u>Component</u>	<u>Wt. %</u>
	1-Phenoxy-2-propanol (Dowanol PPh)	3.0
30	Octylphenol ethoxylate (Triton X-45)	0.2

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	Deionized H <sub>2</sub> O	95.2
5	Acrylic acid/alkyl methacrylate copolymer, 30% aqueous (Acrysol ICS-1)	1.2
	Ammonium hydroxide (28%)	0.2
	Sodium Nitrite	0.2
		<hr/> 100.0

The first four components listed above were  
10 pre-emulsified under high speed stirring for three minutes  
with a water driven impeller, the ammonium hydroxide was  
then very slowly added with vigorous stirring to give  
immediate thickening, and the sodium nitrite was added last  
with vigorous stirring until it was dissolved. The  
15 resulting composition was a white emulsion/fluid with a pH  
of 8.78, a Brookfield viscosity (LV-#2 spindle, 30 rpm) of  
68 centipoise, a total solids content (theory) of 0.79%,  
and a total actives content (theory) of 3.79%.

The above composition was aerosolized in a 6 oz.  
20 aerosol can using 8.32 g (15.0 ml) of a propane-isobutane  
blend propellant (sold under the trade designation A-55).  
The can was equipped with an AR-75 valve and Mark-18-1525  
actuator. The fill ratio was 87/13.

It was found that the resulting aerosol formulation  
25 very easily, quickly and totally removed the following  
markings from alkyd enameled metal surfaces (spray on/wipe  
off): black, indelible Magic Marker felt pen, blue and  
black indelible ballpoint pen, #1 hardness pencil, red  
(waxy) crayon and automotive grease smearings. The aerosol  
30 formulation also readily removed fingerprints, smudges, and  
similar markings from walls and woodwork.

Example 26

An aqueous cleaner/degreaser emulsion was prepared having the following composition:

	<u>Component</u>	<u>Wt. %</u>
5	Phosphate ester coupler/ emulsifier (Monafax 1293)	0.30
	Isostearamide diethanolamide (1:1) (Monamid 150-IS)	0.40
	Monoethanolamine	0.40
10	Deionized H <sub>2</sub> O	192.9
	2-Ethylhexoxyethanol (Ektasolv EEH-Eastman)	2.0
	1-Phenoxy-2-propanol (Dowanol PPh)	4.0
15		<hr/> 200.0

The first four components were stirred at room temperature until fully dispersed. The two organic solvents were then added with vigorous stirring for 0.5 hr. The resulting composition was an intensely  
20 bluish/white emulsion having a pH of 10.20, a Brookfield viscosity (LV-#2 spindle, 60 rpm) of 4.5 centipoise, a total solids content (theory) of 0.35% and a total actives content (theory) of 3.55%. The emulsion exhibited excellent stability characteristics.

25 The emulsion possessed excellent, rapid, and efficient cleaning/degreasing action against the following soilants: black Magic Marker markings, ballpoint pen markings, #1 hardness pencil markings, red (waxy) crayon markings, automotive greases, Vaseline, lard, shortening, and  
30 lipophilic oils.

Example 27

Example 26 was repeated in preparing an aqueous cleaner/degreaser emulsion having the following composition:

	<u>Component</u>	<u>Wt. %</u>
5	Diethanolamine lauryl sulfate (Stepanol DEA, 35%)	0.20
	Isostearamide diethanolamide (1:1) (Monamid 150-IS)	0.40
	Monoethanolamine	0.60
10	Soft H <sub>2</sub> O	192.3
	1-Phenoxy-2-propanol (Dowanol PPh)	5.0
	Acrylic acid/alkyl methacrylate copolymer, 30% aqueous	1.5
15	(Acrysol ICS-1)	
		<hr/> 200.0

The resulting composition was a bluish emulsion (iridescent cast) having a pH of 10.21, a Brookfield viscosity (LV-#2 spindle, 60 rpm) of 72 centipoise, a total solids content (theory) of 0.46% and a total actives content (theory) of 3.26%. The emulsion exhibited excellent stability characteristics.

The emulsion possessed excellent, rapid, and efficient cleaning/degreasing action against all the soilants listed in Example 26.

Example 28

Example 26 was repeated in preparing an aqueous cleaner/degreaser emulsion having the following composition:

	<u>Component</u>	<u>Wt. %</u>
5	Isostearamide diethanolamide (1:1) (Monamid 150-IS)	0.5
	Sodium dodecyldiphenylether disulfonate-coupler (Dowfax 2A1, 45%)	0.1
10	Monoethanolamine	0.6
	Soft H <sub>2</sub> O	190.3
	2-Phenoxyethanol (Dowanol EPh)	7.0
15	Acrylic acid/alkyl methacrylate copolymer, 30% aqueous (Acrysol ICS-1)	1.5
		<hr/> 200.0

The resulting composition was a light, slightly bluish/white emulsion having a pH of 10:08, a Brookfield  
20 viscosity (LV-#2 spindle, 60 rpm) of 57 centipoise, a total solids content (theory) of 0.50% and a total actives content (theory) of 4.30%. The emulsion exhibited excellent stability characteristics.

The emulsion possessed excellent, rapid, and  
25 complete cleaning/degreasing action against all the soilants listed in Example 26.

Example 29

Example 26 was repeated in preparing an aqueous cleaner/degreaser emulsion having the following composition:

	<u>Component</u>	<u>Wt.%</u>
	Isostearamide diethanolamide (1:1) (Monamid 150-IS)	0.3
5	Mixed caprylamide DEA/ capramide DEA coupler (Clintwood CP-6-61-2)	0.2
	Monoethanolamine	0.3
	Soft H <sub>2</sub> O	194.2
10	1-Phenoxy-2-propanol (Dowanol PPh)	5.0
		<hr/> 200.0

The resulting composition was an intensely bluish/white emulsion having a pH of 10.43, a Brookfield viscosity (LV-#2 spindle, 60 rpm) of 4.3 centipoise, a  
15 total solids content (theory) of 0.25% and a total actives content (theory) of 2.90%. The emulsion exhibited excellent stability characteristics.

The emulsion possessed excellent, rapid, and complete cleaning/degreasing action against all the soilants  
20 listed in Example 26.

#### Example 30

An aqueous cleaner/degreaser emulsion was prepared having the following composition:

	<u>Component</u>	<u>Wt.%</u>
25	Isostearamide diethanolamide (1:1) (Monamid 150-IS)	0.30
	Soft H <sub>2</sub> O	194.2
	Butoxyethyl acetate (EB acetate)	3.0

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	Acrylic acid/alkyl methacrylate copolymer, 30% aqueous (Acrysol ICS-1)	1.0
5	Aqueous ammonium hydroxide (28% NH <sub>3</sub> )	0.08
		<hr/> 100.0

The first two components were stirred at room temperature for 15 minutes to completely disperse the isostearamide diethanolamide in water. The butoxyethyl acetate was then added with vigorous stirring at room temperature for 30 minutes. The Acrysol ICS-1 was next added with stirring followed by dropwise addition of the ammonium hydroxide with vigorous stirring at room temperature for 15 minutes.

The resulting composition was a slightly bluish/white, milky emulsion having a pH of 7.17, a Brookfield viscosity (LV-#2 spindle, 60 rpm) of 134 centipoise, a total solids content (theory) of 0.62% and a total actives content (theory) of 3.62%. The emulsion exhibited excellent stability characteristics.

The emulsion possessed excellent, rapid, and complete cleaning/degreasing action against all the soilants listed in Example 26.

#### Example 31

A hand cleaner emulsion was prepared having the following composition:

	<u>Component</u>	<u>Wt. %</u>
30	Polypropylene glycol monobutyl ether (Dow Polyglycol L-1150)	10.0

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	Mineral oil (Penreco, Drakeol 5 LMO)	30.0
	Octylphenol/7-8 E.O. (Triton X-114)	10.0
5	Isostearamide diethanolamide (1:1)	6.0
	Soft H <sub>2</sub> O	141.0
	Acrylic acid/alkyl methacrylate copolymer, 30% aqueous (Acrysol ICS-1)	3.0
10		
		<hr/> 100.0

The first five components were emulsified and the Acrysol ICS-1 was then added with vigorous stirring. The resulting composition was an intensely bluish/white emulsion which had a creamy, smooth feel. The emulsion had a pH of 6.98, a Brookfield viscosity (LV-#4 spindle, 6 rpm) of 9500 centipoise and a total actives content (theory) of 28.45%.

The emulsion exhibited superior removal of oily/greasy soilants from hands. When reformulated to contain no Polyglycol L-1150, the cleaning/degreasing action was drastically reduced.

### Example 32

An aqueous cleaner/degreaser emulsion in the form of an aerosol formulation was prepared having the following composition:

	<u>Component</u>	<u>Wt. %</u>
	Liquid lauramide	0.30
	diethanolamide (1:1 Superamide)	
30	(Mackamide LLM)	
	Monethanolamine	0.60

	Sodium nitrite	0.30
	Perfluoroalkylphosphate ester antifoaming agent (Atsurf F-12, 15%)	0.40
5	Deionized H <sub>2</sub> O	191.80
	1-Phenoxy-2-propanol (Dowanol PPh)	5.00
	Acrylic acid/alkyl methacrylate copolymer,	1.60
10	30% aqueous (Acrysol ICS-1)	
		<hr/> 200.00

The first five components listed above were stirred at high speed for 15 minutes to fully disperse the lauramide diethanolamide and to form a microemulsion. The

- 15 1-phenoxy-2-propanol was then added with vigorous stirring for 30 minutes at room temperature after which the Acrysol ICS-1 was added dropwise with good stirring. The resulting composition was a bluish/white emulsion with a pH of 9.86, a Brookfield viscosity (LV-#2 spindle, 60 rpm) of 28
- 20 centipoise, a total solids content (theory) of 0.57%, and a total actives content (theory) of 3.37%. The emulsion exhibited excellent stability.

The above composition was aerosolized as described in Example 25 using a fill ratio of 100/15.

- 25 It was found that the resulting aerosol formulation produced a moderately wet, fast-breaking foam with excellent vertical cling. The formulation exhibited excellent cleaner/degreaser action against the markings listed in Example 25 and had good/excellent wet-out properties.

Example 33

An aqueous cleaner/degreaser emulsion was prepared having the following composition:

	<u>Component</u>	<u>Wt.%</u>
5	Isostearamide diethanolamide (1:1)(Monamid 150-IS)	8.0
	Monethanolamine	0.95
	Tap Water (pH 9.55, 155ppm hardness)	170.05
10	1-Phenoxy-2-propanol (Dowanol PPh)	20.0
	Perfluoroalkylphosphate ester antifoaming agent (Atsurf F-12, 15%)	1.0
15		<hr/> 200.00

The first three components listed above were stirred until the mixture was fully homogeneous and formed a microemulsion. The 1-phenoxy-2-propanol was then stirred into the microemulsion with stirring continued for one hour at room temperature after which the antifoaming agent was added with stirring. The resulting composition was a very intense bluish white emulsion having a pH of 10.53, a Brookfield viscosity (LV-#2 spindle, 60 rpm) of 7.5 centipoise, a total solids content (theory) of 4.08%, and a total actives content (theory) of 14.55%. The emulsion exhibited excellent stability.

At a 1:5 dilution with water, a bluish to bluish/white microemulsion formed which very easily, quickly, and completely removed all of the markings set forth in Examples 2-4 from alkyd enameled metal surfaces.

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The microemulsion was subjected to the degreasing test method of Example 1 with the following results:

- 1st attack on greased slide at 1 sec.  
 45% removal of grease at 10 sec.  
 5 75% removal of grease at 15 sec.  
 100% removal of grease at 20 sec.

This emulsion composition is especially suitable for use in mechanized high pressure/spray equipment where foam generation cannot be tolerated.

10

Example 34

An aqueous cleaner/degreaser emulsion was prepared having the following composition:

	<u>Component</u>	<u>Wt. %</u>
15	Phosphate ester coupler/ emulsifier (Monafax 1293)	0.10
	Isostearamide diethanolamide (1:1)(Monamid 150-IS)	0.40
	Monethanolamine	0.60
	Soft H <sub>2</sub> O	192.40
20	1-Phenoxy-2-propanol (Dowanol PPh)	5.00
	Acrylic acid/alkyl Methacrylate copolymer 30% aqueous (Acrysol ICS-1)	1.50
25		<u>200.00</u>

The first four components listed above were stirred at room temperature until fully dispersed (ca 15 minutes). The 1-phenoxy-2-propanol was added with vigorous stirring

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for 0.5 hour at room temperature and the Acrysol ICS-1 was added dropwise with vigorous stirring to viscosify the composition. The resulting composition was an intensely bluish/white emulsion having a pH of 10.38, a Brookfield viscosity (LV-#2 spindle, 60 rpm) of 49 centipoise, a total solids content (theory) of 0.48%, and a total actives content (theory) of 3.28%. The emulsion exhibited excellent stability.

The emulsion exhibited excellent cleaner/degreaser action against all of the markings set forth in Examples 2-4 and against Vaseline, lard, shortening and lipophilic oils.

This emulsion is suitable for use as a ready-to-use formulation applied by pump spray or trigger spray action.

#### Example 35

An aqueous cleaner/degreaser emulsion was prepared having the following composition:

	<u>Component</u>	<u>Wt. %</u>
	Polyglycol copolymer containing ethylene oxide and propylene oxide (Dow Polyglycol 112-2)	3.0
	Octylphenol ethoxylate (5 E.O.) (Triton X-45)	0.3
	Soft H <sub>2</sub> O	96.7
		<hr/> 100.00

The water was added very slowly to the stirred mixture of the other two components listed above. The formulation goes through a water/oil to oil/water transformation to form a bluish/white emulsion without the addition of a viscosifying thickener.

The emulsion had a pH of 7.67, a Brookfield viscosity (LV-#2 spindle, 30 rpm) of 53 centipoise and a total solids/total actives content (theory) of 3.3%.

This emulsion readily removed tar, grease, asphalt, black (rubber) heel and red (waxy) crayon marks from floor tile coated with polymeric floor finish using a wetted paper towel or cloth. The tile buffs to a clear, colorless, high shine on air drying with no damage/solvent action on the floor finish.

10

Example 36

An aqueous cleaner/degreaser emulsion was prepared having the following composition:

	<u>Component</u>	<u>Wt. %</u>
15	Polypropylene glycol (Dow P-2000)	6.0
	Soft H <sub>2</sub> O	190.8
	Octylphenol ethoxylate (5 E.O.) (Triton X-45)	0.6
	Triethanolamine	0.6
20	Acrylic acid/alkyl Methacrylate copolymer 30% aqueous (Acrysol ICS-1)	2.0
		<hr/> 200.00

The first four components listed above were pre-emulsified with high speed stirring and the Acrysol ICS-1 was added dropwise under vigorous high speed/high shear stirring conditions. The resulting composition was a white, creamy

emulsion having a pH of 7.81, a Brookfield viscosity (LV-#3 spindle, 12 rpm) of 870 centipoise and a total solids/total actives content (theory) of 3.9%.

5 This emulsion readily removed tar, grease, asphalt, black (rubber) heel and red (waxy) crayon marks from vinyl tile coated with polymeric floor finish using a wetted paper towel or cloth. The tile buffs to a clear, colorless, high shine on air drying with no damaging solvent action occurring on the floor finish.

10 In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As various changes could be made in the above compositions without departing from the scope of the  
15 invention, it is intended that all matter contained in the above description shall be interpreted as illustrative and not in a limiting sense.

## WHAT IS CLAIMED IS:

1. A stable, aqueous cleaner/degreaser emulsion composition comprising:

(a) at least one sparingly soluble organic solvent characterized by:

- 5 (i) having a water solubility in the range of approximately 0.05 to approximately 6 weight percent;
- (ii) not being a hydrocarbon or halocarbon;
- 10 (iii) having one or more similar or dissimilar oxygen, nitrogen, sulfur, or phosphorous containing functional groups;
- (iv) being a solvent for hydrophobic
- 15 soilants; and
- (v) being present in an amount exceeding its aqueous solubility;

(b) a solubilizing additive consisting of from approximately 0.1 to approximately 100 weight percent of

20 a surfactant and from 0 to approximately 99.9 weight percent of a coupler, said solubilizing additive being present in an amount insufficient to solubilize all of the total organic solvent content but sufficient to emulsify the unsolubilized portion of the total organic solvent content; and

25 (c) water.

2. A stable, aqueous cleaner/degreaser emulsion composition as set forth in claim 1 further comprising a viscosifying thickener.

3. A stable, aqueous cleaner/degreaser emulsion composition as set forth in claim 1 wher in said organic solvent has a water solubility in the range of approximately 0.05 to approximately 2.5 weight percent.

4. A stable, aqueous cleaner/degreaser emulsion composition as set forth in claim 1 wherein said organic solvent is selected from the group consisting of esters, alcohols, ketones, aldehydes, ethers, and nitriles.

5. A stable, aqueous cleaner/degreaser emulsion composition as set forth in claim 1 wherein said solvent is selected from the group consisting of 2-phenoxyethanol, 1-phenoxy-2-propanol, dipropylene glycol monobutyl ether, polypropylene glycols,  $\beta$ -phenylethanol, acetophenone, benzyl alcohol, butoxyethyl acetate, isophorone and the dimethyl esters of mixed succinic, glutaric, and adipic acids.

6. A stable, aqueous cleaner/degreaser emulsion composition as set forth in claim 1 wherein said surfactant is selected from the group consisting of nonionic, anionic, cationic, and amphoteric surfactants.

7. A stable, aqueous cleaner/degreaser emulsion composition as set forth in claim 6 wherein said surfactant is a nonionic surfactant.

8. A stable, aqueous cleaner/degreaser emulsion composition as set forth in claim 7 wherein said nonionic surfactant is selected from the group consisting of alkoxy poly(ethenoxy)alkanols, alkylphenoxy poly(ethenoxy) alkanols and fatty acid alkanolamide surfactants.

9. A stable, aqueous cleaner/degreaser emulsion composition as set forth in claim 7 wherein said nonionic surfactant is selected from the group consisting of octylphenoxy poly(ethyleneoxy)(4)ethanol, nonylphenoxy poly(ethyleneoxy)(5)ethanol, dodecylphenoxy poly(ethyleneoxy)(8)ethanol, polyoxyethylene (7) lauryl alcohol, polyoxyethylene (4) tridecyl alcohol, lauryloxy poly(ethyleneoxy)(8)ethyl methyl ether, undecylthiopoly(ethyleneoxy)(6)ethanol, methoxypoly(oxyethylene(10))/(oxy-

- 10 propylene(20))-2-propanol block copolymer, nonyloxy-poly(propyleneoxy)(4)/(ethyleneoxy)(10)ethanol, dodecyl polyglycoside, polyoxyethylene (9) monolaurate, polyoxyethylene (8) monoundecanoate, polyoxyethylene (20) sorbitan monostearate, polyoxyethylene (18) sorbitol
- 15 monotallate, sucrose monolaurate, lauramidopropyl-N,N-dimethylamine oxide, 1:1 lauric diethanolamide, 1:1 coconut diethanolamide, 1:1 mixed fatty acid diethanolamide, polyoxyethylene(6)lauramide, 1:1 soya diethanolamidopoly(ethyleneoxy)(8)ethanol, 1:1 soyamide
- 20 diethanolamide, 1:1 linoleamide diethanolamide, 1:1 oleamide diethanolamide, 1:1 ricinoleamide diethanolamide, 1:1 isostearamide diethanolamide, 2:1 oleamide diethanolamide, 2:1 soyamide diethanolamide, and 1:1 tall oil diethanolamide.

10. A stable, aqueous cleaner/degreaser emulsion composition as set forth in claim 1 wherein said surfactant is an anionic surfactant selected from the group consisting of dodecylbenzene sulfonic acid, monoethanolamine

- 5 dodecylbenzene sulfonate, sodium dodecylbenzene sulfonate, potassium dodecylbenzene sulfonate, triethanolamine dodecylbenzene sulfonate, morpholinium dodecylbenzene sulfonate, ammonium dodecylbenzene sulfonate, isopropylamine dodecylbenzene sulfonate, sodium tridecylbenzene
- 10 sulfonate, sodium dinonylbenzene sulfonate, potassium didodecylbenzene sulfonate, dodecyl diphenyloxide disulfonic acid, sodium dodecyl diphenyloxide disulfonate, isopropylamine decyl diphenyloxide disulfonate, sodium hexadecyloxypoly(ethyleneoxy)(10)ethyl sulfonate, potassium
- 15 octylphenoxypoly(ethyleneoxy)(9)ethyl sulfonate, sodium alpha C<sub>12-14</sub> olefin sulfonate, sodium hexadecane-1 sulfonate, sodium ethyl oleate sulfonate, potassium octadec nylsuccinate, sodium oleate, potassium laurate,

triethanolamine myristate, morpholinium tallate, potassium  
20 tallate, sodium lauryl sulfate, diethanolamine lauryl  
sulfate, sodium laureth (3) sulfate, ammonium laureth (2)  
sulfate, sodium nonylphenoxy poly(ethyleneoxy)(4) sulfate,  
sodium decyloxypoly(ethyleneoxy)(5)methylcarboxylate,  
sodium octylphenoxy poly(ethyleneoxy)(8)methylcarboxylate,  
25 sodium mono decyloxypoly(ethyleneoxy)(4)phosphate, sodium  
didecyloxypoly(ethyleneoxy)(6)phosphate, and potassium  
mono/di octylphenoxy poly(ethyleneoxy)(9)phosphate.

11. A stable, aqueous cleaner/degreaser emulsion  
composition as set forth in claim 1 wherein said surfactant  
is a cationic surfactant selected from the group consisting  
of a mixture of n-alkyl dimethyl ethylbenzyl ammonium  
5 chlorides, hexadecyltrimethylammonium methosulfate,  
didecyldimethylammonium bromide and a mixture of n-alkyl  
dimethyl benzyl ammonium chlorides.

12. A stable, aqueous cleaner/degreaser emulsion  
composition as set forth in claim 1 wherein said surfactant  
is an amphoteric surfactant selected from the group  
consisting of cocamidopropyl betaine, sodium palmitylo-  
5 amphopropionate, N-coco beta-aminopropionic acid, disodium  
N-lauryliminodipropionate, sodium coco imidazoline  
amphoglycinate and coco betaine.

13. A stable, aqueous cleaner/degreaser emulsion  
composition as set forth in claim 1 wherein said coupler is  
selected from the group consisting of sodium benzene  
sulfonate, sodium toluene sulfonate, sodium xylene  
5 sulfonate, potassium ethylbenzene sulfonate, sodium cumene  
sulfonate, sodium octane-1-sulfonate, potassium  
dimethylnaphthalene sulfonate, ammonium xylene sulfonate,  
sodium n-hexyl diphenyoxide disulfonate, sodium  
2-ethylhexyl sulfate, ammonium n-butoxyethyl sulfate,  
10 sodium 2-ethylhexanoate, sodium pelargonate, sodium

n-butoxymethyl carboxylate, potassium mono/di phenoxyethyl phosphate, sodium mono/di n-butoxyethyl phosphate, triethanolamine trimethylolpropane phosphate, sodium capryloamphopropionate, disodium capryloiminodipropionate, 15 sodium isodecyloxypropyliminodipropionate, and sodium caproimidazoline amphoglycinate, and mixed caprylamide DEA/capramide DEA.

14. A stable, aqueous cleaner/degreaser emulsion composition as set forth in claim 2 wherein said viscosifying thickener is selected from the group consisting of acrylic acid/alkyl methacrylate copolymers, 5 carboxy acrylic polymers, polyacrylic acid crosslinked with polyalkenyl polyethers, polyacrylamide, poly(methylvinyl ether/Maleic) anhydride, guar gums, xanthan gums, bentonite clays, organically modified magnesium aluminum silicates, fumed silica, sodium alginate, polyethylene glycols, 10 polyethylene oxide, hydroxyethyl cellulose, hydroxypropyl cellulose, and carboxymethyl cellulose.

15. A stable, aqueous cleaner/degreaser emulsion composition as set forth in claim 1 wherein said emulsion additionally comprises one or more optional adjuvants selected from the group consisting of chelants, defoamers, 5 foam control agents, preservatives, fragrances, dyes, lubricants, emollients, pH adjustants, dispersants, abrasives, anti-corrosion additives, and anti-rust additives.

16. A stable, aqueous cleaner/degreaser emulsion composition as set forth in claim 1 wherein said organic solvent is 1-phenoxy-2-propanol.

17. A stable, aqueous cleaner/degreaser emulsion composition as set forth in claim 1 wherein said organic solvent is 2-phenoxyethanol.

18. A stable, aqueous cleaner/degreaser emulsion composition as set forth in claim 1 wherein said organic solvent is a polypropylene glycol.

19. A stable, aqueous cleaner/degreaser emulsion composition as set forth in claim 1 wherein said organic solvent is dipropylene glycol monobutyl ether.

20. A stable, aqueous cleaner/degreaser emulsion composition as set forth in claim 1 wherein said surfactant is 1:1 isostearamide diethanolamide.

21. A stable, aqueous cleaner/degreaser emulsion composition as set forth in claim 1 wherein said surfactant is 1:1 ricinoleamide diethanolamide.

22. A stable, aqueous cleaner/degreaser emulsion composition as set forth in claim 1 wherein said surfactant is 1:1 soyamide diethanolamide.

23. A stable, aqueous cleaner/degreaser emulsion composition as set forth in claim 1 wherein said surfactant is 1:1 linoleamide diethanolamide.

24. A stable, aqueous cleaner/degreaser emulsion composition as set forth in claim 1 wherein said surfactant is 1:1 oleamide diethanolamide.

25. A stable, aqueous cleaner/degreaser emulsion composition as set forth in claim 1 wherein said surfactant is dodecylbenzene sulfonic acid.

26. A stable, aqueous cleaner/degreaser emulsion composition as set forth in claim 1 wherein said surfactant is nonylphenoxy poly(ethyleneoxy)(8.5) ethanol.

27. A stable, aqueous cleaner/degreaser emulsion composition as set forth in claim 1 wherein said coupler is sodium isodecyloxypropyliminodipropionate.

28. A stable, aqueous cleaner/degreaser emulsion composition as set forth in claim 2 wherein said viscosifying thickener is an acrylic acid/alkyl methacrylate copolymer.

29. A stable, aqueous cleaner/degreaser emulsion composition as set forth in claim 2 wherein said viscousifying thickener is a neutralized acrylic acid/alkyl methacrylate copolymer.

30. A stable, aqueous cleaner/degreaser emulsion composition comprising:

- (a) 1-phenoxy-2-propanol in an amount exceeding its aqueous solubility;
- 5 (b) 1:1 isostearamide diethanolamide in an amount insufficient to solubilize all of said 1-phenoxy-2-propanol but sufficient to emulsify the unsolubilized portion of said
- 10 1-phenoxy-2-propanol; and
- (c) water.

31. A stable, aqueous cleaner/degreaser emulsion composition comprising:

- (a) 2-phenoxyethanol in an amount exceeding its aqueous solubility;
- 5 (b) 1:1 isostearamide diethanolamide in an amount insufficient to solubilize all of said 2-phenoxyethanol but sufficient to emulsify the unsolubilized portion of said
- 10 2-phenoxyethanol; and
- (c) water.

32. A stable, aqueous cleaner/degreaser emulsion composition comprising:

- (a) a polypropylene glycol having a water solubility in the range of
- 5 approximately 0.05 to approximately 6 weight percent and being present in an amount exceeding its aqueous solubility;

10 (b) a fatty acid alkanolamide in an amount insufficient to solubilize all of said polypropylene glycol but sufficient to emulsify the unsolubilized portion of said polypropylene glycol; and

(c) water.

33. A stable, aqueous cleaner/degreaser aerosol emulsion composition comprising:

(a) 1-phenoxy-2-propanol in an amount exceeding its aqueous solubility;

5 (b) 1:1 lauramide diethanolamide in an amount insufficient to solubilize all of said 1-phenoxy-2-propanol but sufficient to emulsify the unsolubilized portion of said 1-phenoxy-2-propanol;

10

(c) a viscosifying thickener; and

(d) water.

# INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 90/07215

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (if several classification symbols apply, indicate all) <sup>1</sup> According to International Patent Classification (IPC) or to both National Classification and IPC <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <span>US 252/153</span> <span>Int. Cl. (5) C11D 7/32</span> </div>		
<b>II. FIELDS SEARCHED</b> <div style="text-align: right; margin-right: 100px; font-size: small;">Minimum Documentation Searched <sup>4</sup></div> <div style="display: flex; justify-content: space-between; margin-top: 5px;"> <span style="width: 20%;">Classification System</span> <span>Classification Symbols</span> </div> <div style="margin-top: 10px;"> <div style="display: flex; justify-content: space-between;"> <span>US</span> <span>252/153, 162, 170, 171, 173, 174.19, 174.21, 174.22 364 534, 535, 540 and Dig. 14</span> </div> <div style="text-align: center; margin-top: 10px; font-size: x-small;">             Documentation Searched other than Minimum Documentation              to the Extent that such Documents are included in the Fields Searched <sup>6</sup> </div> </div>		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT</b> <sup>14</sup>		
<b>Category *</b>	<b>Citation of Document, <sup>16</sup> with indication, where appropriate, of the relevant passages <sup>17</sup></b>	<b>Relevant to Claim No. <sup>18</sup></b>
X	US, 4,769,172 (Siklosi) 06 September 1988 see column 4, lines 17-45, Examples VI-X and XIII	1-13
Y	US, 4,832,802 (Canaris) 05 May 1989 see column 5, lines 58-63	1-13
Y	US 4,040,977 (Eggensperger, et al.) 09 August 1977 see column 2, lines 53-60 and col. 3, lines 32-52	1-13
Y	US, 4,460,374 (Abel, et al) 17 July 1983	1-13
<div style="display: flex; justify-content: space-between; font-size: x-small;"> <div style="width: 45%;"> <p><b>* Special categories of cited documents: <sup>15</sup></b></p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"&amp;" document member of the same patent family</p> </div> </div>		
<b>IV. CERTIFICATION</b>		
<b>Date of the Actual Completion of the International Search <sup>2</sup></b> <div style="text-align: center; margin-top: 10px; font-size: large;">18 February 1991</div>		<b>Date of Mailing of this International Search Report <sup>3</sup></b> <div style="text-align: center; margin-top: 10px; font-size: x-large; font-weight: bold;">11 APR 1991</div>
<b>International Searching Authority <sup>1</sup></b> ISA/US		<b>Signature of Authorized Officer <sup>7</sup></b> <i>Nguyen Ngoc Ho</i> NGUYEN NGOC-HO John F. McNally <b>INTERNATIONAL DIVISION</b>